

## PRETREATMENT APPARATUS FOR PLATING

**Publication number:** JP11080990

**Publication date:** 1999-03-26

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**Classification:**

- international: **C25D5/34; C25D17/00; C25D5/34; C25D17/00;** (IPC1-7): C25D5/34; C25D17/00

- European:

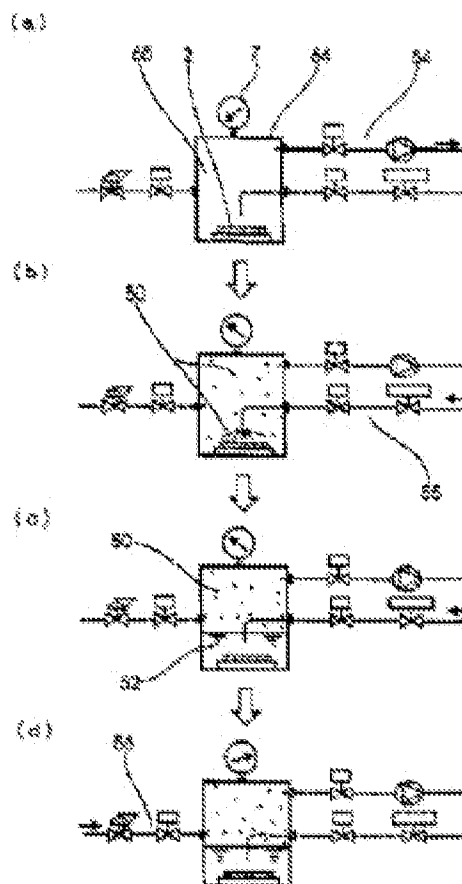
**Application number:** JP19970265027 19970911

**Priority number(s):** JP19970265027 19970911

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### Abstract of JP11080990

**PROBLEM TO BE SOLVED:** To make it possible to plate with complete metal filling by first subjecting a substrate to vacuum treatment, then dipping the substrate into a plating liquid, and pressurizing the plating liquid in order to allow it to penetrate into the fine groove of the substrate. **SOLUTION:** The pretreatment for plating is carried out by putting the substrate 2 in the closed vessel 64, which is capable of being evacuated, then evacuating the vessel up to about 0.01 Torr through the evacuating arrangement 54 using a pump, further introducing a plating liquid, highly pure water, an alcohol and a surfactant of normal temp. and pressure through the liquid introducing pipe arrangement into the vessel, dipping the substrate 2 into the plating liquid 52, and pressurizing the plating liquid 52 so as to crush air bubbles which survive at the inner surface of the fine groove of the substrate 2 and to allow the plating liquid 52 to penetrate into the fine groove. Further, at that time, it is preferable to sonicate the plating liquid 52 in order to add the vibrating pressure on the substrate 2.



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(19)日本国特許庁 (J P)

(12) 公 開 特 許 公 報 (A)

(11)特許出願公開番号

特開平11-80990

(43)公開日 平成11年(1999) 3月26日

(51)Int.Cl.<sup>6</sup>

C 2 5 D 5/34  
17/00

識別記号

F I

C 2 5 D 5/34  
17/00

L

審査請求 未請求 請求項の数8 F D (全 6 頁)

(21)出願番号 特願平9-265027

(22)出願日 平成9年(1997) 9月11日

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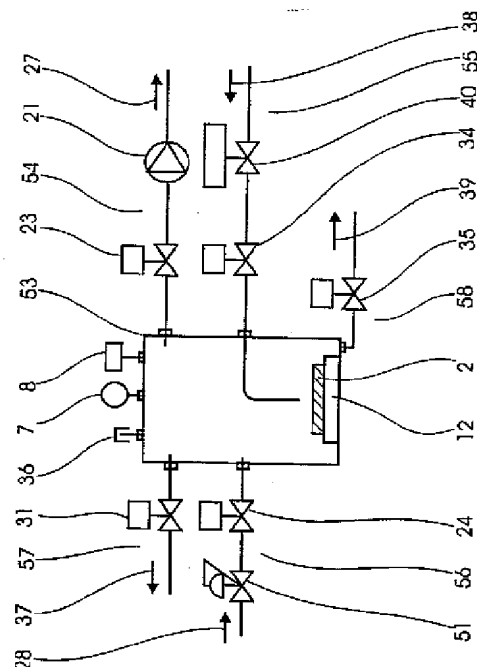
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(54)【発明の名称】 めっき前処理装置

(57)【要約】

【課題】 ウェーハ基板上にパターン形成された微細溝への良好な金属埋め込みをめっき法により行うため、めっきプロセスとしてめっき液を確実にその微細溝に浸入させることのできるめっき用前処理方法及びその装置を提供する。

【解決手段】 表面に微細窪み62を有する基板2に、微細窪み62を充填するようにめっきを行なうためのめっき前処理方法において、基板2を含む雰囲気を排気する工程と、基板2を液体52に浸漬させる工程と、基板2を包囲する液体52を加圧する工程とを有する。



**【特許請求の範囲】**

【請求項1】 表面に微細窪みを有する基板に、該微細窪みを充填するようにめっきを行なうためのめっき前処理方法において、  
前記基板を含む雰囲気を排気する工程と、  
前記基板を液体に浸漬させる工程と、  
前記基板を包囲する液体を加圧する工程とを有することを特徴とするめっき前処理方法。

【請求項2】 さらに、前記基板を包囲する液体に圧力変動を与える工程を有することを特徴とする請求項1に記載のめっき前処理方法。

【請求項3】 前記液体として、水、アルコール、又はめっき液又はこれらの混合液を用いることを特徴とする請求項1に記載のめっき前処理方法。

【請求項4】 前記浸漬工程において、基板の濡れ性を改善する表面活性剤を用いることを特徴とする請求項1に記載のめっき前処理方法。

【請求項5】 表面に微細窪みを有する基板に、該微細窪みを充填するようにめっきを行なうためのめっき前処理装置において、  
密閉可能な処理室と、  
該処理室の排気を行う真空排気経路と、  
前記処理室に液体を供給するための液導入経路と、  
前記処理室内の液体を加圧するためのガス導入経路と、  
前記処理室からガスを排出するためのガス排出経路とを有することを特徴とするめっき前処理装置。

【請求項6】 さらに、前記処理室内の液体に圧力変動を与える圧力変動手段を有することを特徴とする請求項5に記載のめっき前処理装置。

【請求項7】 前記圧力変動手段は、前記ガス導入経路及びガス排出経路の少なくとも一方に設けられた開閉又は切替弁装置であることを特徴とする請求項6に記載のめっき前処理装置。

【請求項8】 前記圧力変動手段は、超音波振動器であることを特徴とする請求項6に記載のめっき前処理装置。

**【発明の詳細な説明】****【0001】**

【発明の属する技術分野】本発明は半導体の次世代配線技術である金属配線形成技術に関し、特に基板上に形成された微細溝にめっきにより金属の埋め込みを行うためのめっきの前処理方法およびその装置に関するものである。

**【0002】**

【従来の技術】半導体を用いた集積回路において、回路配線材料にはアルミニウムが多く用いられてきた。アルミニウム配線は、スパッタリング法(Sputtering)により基板にアルミニウム膜を付けた後レジスト形成によりパターニングを行い、エッチングにより配線形成される。回路の高度集積化に伴い、配線幅がより狭く形成さ

れることが要求されるようになってきたが、アルミニウムの材料特性上諸問題が生じるようになってきた。他の金属材料による配線形成には従来の上記回路形成が困難な場合があり、配線用の溝や穴をあらかじめ形成し、化学気相成長法(Chemical Vapor Deposition:以下CVD法)、スパッタリング法やめっき法などの手法により金属を溝の中に埋め込み、その後表面を化学機械研磨(Chemical Mechanical Polishing:以下CMP)で表面研磨し、回路配線を形成する方法がとられてきた。

【0003】めっき法は、金属の膜付け方法としては広く用いられており、多くの特長を有する。図6は基本的なめっき装置を示すもので、めっき槽1内のめっき液9中に、被めっき基板2を取り付けたアノード電極4およびカソード電極3を対向して配置し、めっき操作中、めっき液攪拌用の攪拌器11がめっき液9を攪拌するものであった。めっきの前処理としては被めっき基板の洗浄又はエッチング等が行われており、被めっき基板上の微細溝へのめっき液注入を良好にするための前処理は一般的には行われていなかった。

**【0004】**

【発明が解決しようとする課題】めっき法は他のプロセスに比べて、プロセスコストが安い、純度の高い材料が得られる、熱的影響の少ない低温プロセスが可能となる等の特長がある反面、ウェーハ基板上に形成された微細溝にめっき液が完全に浸透しない等の不具合があった。特に、アスペクト比の大きい、深い微細溝でのめっきによる金属埋め込みはほとんど行われていないのが実状であった。

【0005】微細溝が形成された被めっき基板をめっき液に浸漬させる場合、通常その微細溝には空気が残留し、図7のように、完全にはめっき液が浸透しない。これは被めっき基板のぬれ性やめっき液の表面張力等の影響によるものと考えられ、微細溝の幅が狭くなるほど、その傾向は強くなる。

【0006】そこで本発明は、ウェーハ基板上にパターン形成された微細溝への良好な金属埋め込みをめっき法により行うため、めっきプロセスとしてめっき液を確実にその微細溝に浸入させることのできるめっき用前処理方法及びその装置を提供することを目的とする。

**【0007】**

【課題を解決するための手段】請求項1に記載の発明は、表面に微細窪みを有する基板に、該微細窪みを充填するようにめっきを行なうためのめっき前処理方法において、前記基板を含む雰囲気を真空中に排気する工程と、前記基板を液体に浸漬する工程と、前記基板を包囲する液体を加圧する工程とを有することを特徴とするめっき前処理方法である。

【0008】これにより、基板の表面から空気などの不凝縮ガスを排気した後、常温常圧で液体の物質をその容器に導入し、被めっき基板がその液に浸漬すると、被め

つき基板の表面はその液に接する。基板上の微細溝には表面張力等の別の力が作用するため微細溝内には液体蒸気の気泡が存在するが、圧力を作用させることによりその気泡を潰し、微細溝に液体を導入することができる。

【0009】請求項2に記載の発明は、さらに、前記基板を包囲する液体に圧力変動を与える工程を有することを特徴とする請求項1に記載のめっき前処理方法である。これにより、液体蒸気の気泡を潰し、微細溝への液体の導入をさらに促進することができる。

【0010】請求項3に記載の発明は、前記液体として、水、アルコール、又はめっき液又はこれらの混合液を用いることを特徴とする請求項1に記載のめっき前処理方法である。これらの液体種類の選択は、基板との濡れ性や後のめっき処理との関連を考慮して行なう。

【0011】請求項4に記載の発明は、前記浸漬工程において、基板の濡れ性を改善する表面活性剤を用いることを特徴とする請求項1に記載のめっき前処理方法である。これにより、基板との濡れ性を低下させて液体の微細溝への導入を容易にする。これらは、液体に事前に添加しておいてもよいが、液体表面活性剤を先に導入し、微細溝内表面のぬれ性改善を行った後、液体を導入するようにしてもよい。

【0012】請求項5に記載の発明は、表面に微細窪みを有する基板に、該微細窪みを充填するようにめっきを行なうためのめっき前処理装置において、密閉可能な処理室と、該処理室の排気を行う真空排気経路と、前記処理室に液体を供給するための液導入経路と、前記処理室内の液体を加圧するためのガス導入経路と、前記処理室からガスを排出するためのガス排出経路とを有することを特徴とするめっき前処理装置である。

【0013】処理基板を複数同時に処理してもよく、一枚ずつバッチ式に行ってもよい。工程的な処理を行なうには、液体を排出する排液経路を設けておくのが便利である。また、前処理装置をめっき装置と兼用するようにしてもよい。液導入経路を複数設けて、異なる種類の液体や界面活性剤を連続又は同時に導入可能にしてもよい。

【0014】請求項6に記載の発明は、さらに、前記処理室内の液体に圧力変動を与える圧力変動手段を有することを特徴とする請求項5に記載のめっき前処理装置である。請求項7に記載の発明は、前記圧力変動手段は、前記ガス導入経路及びガス排出経路の少なくとも一方に設けられた開閉又は切替弁装置であることを特徴とする請求項6に記載のめっき前処理装置である。請求項8に記載の発明は、前記圧力変動手段は、超音波振動器であることを特徴とする請求項6に記載のめっき前処理装置である。

【0015】

【発明の実施の形態】図1は本発明の実施の形態のめっき前処理装置の概要を示す図である。この前処理装置

は、密閉可能な容器状の処理室53と、これに接続された真空排気配管54、液導入配管55、ガス導入配管56及びガス排出配管57とを主な構成要素としている。処理室53には、圧力計7、圧力スイッチ8および安全弁36が取り付けられ、また、基板2を載せる基板台12が処理室53に設けられている。

【0016】真空排気配管54は、開閉弁23および真空ポンプ21を備えており、処理室53を必要な低圧にまで真空排気することができる。液導入配管55は、図示しない液体源が開閉弁34及びフローメータ40を介して処理装置53の基板台上に開口するノズルに接続され、目的とする所定量の液を処理室53に導入することができる。ガス導入配管56には、レギュレータ51と開閉弁24が設けられ、ガス排出配管57は開閉弁31を介して大気に開口している。さらに、開閉弁35を設けた液排出装置58が処理室53の最下部に接続されている。ガス導入装置56と液排出装置58を連動させることにより液の排出及びブローが可能である。

【0017】このような構成の装置を用いて、めっきの前処理を行なう工程を説明する。被処理基板には、図7と同様の、例えば幅 $0.2\mu\text{m}$ 、深さが $0.8\mu\text{m}$ であるような微細溝が形成されている。この基板2を密閉容器の台上に載置し、排気弁23を開いて排気ポンプ21により真空引きを行い、図2(a)に示すように、真空排気配管54より空気などの不凝縮ガス27を $0.01\text{ Torr}$ 程度まで排気する。

【0018】次に、図2(b)に示すように、液導入配管55から、常温常圧でめっき液、純度の高い水、アルコール等の適宜の液体をノズルを介して密閉容器64に導入する。液体は、最初は容器内で蒸発して空間に気体50として存在する。さらに液体が供給されて、密閉容器64内の圧力が飽和蒸気圧に達すると、同図(c)に示すように、液体52として容器内に溜まり、基板2がその液に浸漬すると基板2の表面はその液に接する。

【0019】この状態において、基板2上の微細溝62の内面には、表面張力等の別の力が作用するため、蒸気の気泡が残存する。そこで、同図(d)に示すように、ガス導入弁24を開いて、ガス導入配管56より密閉容器64内にガス28を導入して加圧する、もしくは圧力振動を作用させることにより、その気泡を潰し、液を微細溝内に浸入させる。図1の例では、圧力振動は、ガス導入配管56よりガスで加圧しながら、ガス排出配管57の開閉弁31を図示しない駆動機構によって短いサイクルで開閉することにより、付与する。

【0020】なお、液体として、基板2の材質に対して表面張力の小さい物質を選ぶことにより、もしくは液に表面活性剤を添加することにより、より確実に且つ効率よく液を微細溝に浸入させることができる。

【0021】このような前処理の後に、基板2を処理室53から取り出し、その表面が乾燥しないようにして図

6に示すめっき槽1へ搬入し、めっき液9に浸漬させて電解めっき又は無電解めっきを行なう。前処理によって所定の液体が基板2の微細溝62に浸入しているので、このような微細溝62の内面にもめっき液9が供給されて該内面のめっきが促進される。

【0022】なお、図1の装置では、基板2を一枚ずつ処理しているが、複数枚を同時に処理するようにしてもよい。この場合、基板2を複数枚その表面を露出するようにして収容するカセットを用いると、前処理前あるいは前処理済みの基板2を処理室53からカセットごと取り出すことができて出し入れの効率が良い。また、カセットが液体を保持可能であれば、取り出した状態でも基板2の乾燥を防止することができる。一方、処理室53とめっき装置を兼用することも可能であり、この場合は前処理に続いてめっき処理を連続して行なうことができる。

【0023】図3は、本発明の別の実施の形態のめっき前処理装置の概要を示す図である。本装置は、図1に示すめっき前処理装置と略同様であるが、圧力振動を与える方式が異なる。すなわち、ガス導入配管56とガス排気配管57がロータリーバルブ59を介して分岐している。そして、ロータリーバルブ59の回転により、処理室53がガス導入配管56とガス排気配管57とに交互に切り替わり、大きい圧力変動を与えることができる。

【0024】図4は本発明の別の実施の形態のめっき前処理装置の概要を示す図である。本装置は、図1に示すめっき前処理装置と略同様であるが、処理室53の圧力に変動を与える方式が異なる。すなわち、処理室53内に超音波振動器60が配置されており、超音波振動器60と基板2とが液体52に浸漬された後、超音波振動器60を作動させて基板2に圧力振動を与えることができる。

【0025】図5は本発明の別の実施の形態のめっき前処理装置の概要を示す図である。本装置は、図1に示すめっき前処理装置と略同様であるが、液導入配管55が複数の液導入系統を持っている点が異なっている。これにより、処理室53に複数種の液を連続または同時に供給することができる。従って、被処理基板の種類や処理条件に応じて、沸点等物性の異なる液や表面活性剤等の添加物を所定量および所定の手順で処理室53に供給することができる。

#### 【0026】

【発明の効果】以上説明したように、この発明によれば、基板の表面から空気などの不凝縮ガスを排気した後、常温常圧で液体の物質をその容器に導入し、さらに圧力を作用させることにより微細溝に液体を導入することができる。従って、ウェーハ基板上にパターン形成された微細溝へめっき液を確実に浸入させることができ、めっきにより良好な金属埋め込みを行なうことができる。

#### 【図面の簡単な説明】

【図1】本発明に基づく実施形態のめっき前処理装置の概要図である。

【図2】基板上の微細溝への液注入プロセスを示す概要図である。

【図3】本発明に基づく実施形態のめっき前処理装置の概要図である。

【図4】本発明に基づく実施形態のめっき前処理装置の概要図である。

【図5】本発明に基づく実施形態のめっき前処理装置の概要図である。

【図6】一般のめっき装置の概要図である。

【図7】液中にある基板上の微細溝に残留する気泡を示す概要図である。

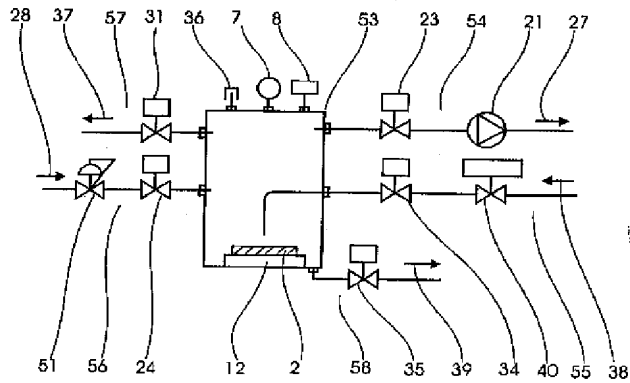
#### 【符号の説明】

- 1 めっき槽
- 2 基板
- 3 カソード電極
- 4 アノード電極
- 5 電源
- 6 温度検知器
- 7 圧力計
- 8 圧力スイッチ
- 9 めっき液
- 11 攪拌器
- 12 基板台
- 21 真空ポンプ
- 23 開閉弁
- 24 開閉弁
- 27 排ガス流れ方向
- 28 導入ガス流れ方向
- 31 開閉弁
- 34 開閉弁
- 35 開閉弁
- 36 安全弁
- 37 排気ガス流れ方向
- 38 導入液流れ方向
- 39 排出液流れ方向
- 40 フローメータ
- 50 蒸気
- 51 レギュレータ
- 52 液
- 53 処理室
- 54 真空排気配管
- 55 液導入配管
- 56 ガス導入配管
- 57 ガス排出配管
- 58 液排出配管
- 59 ロータリーバルブ
- 60 超音波振動器

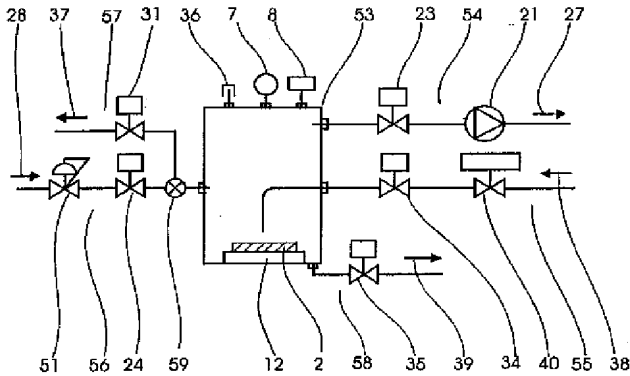
61 めっき面  
62 微細溝  
63 気泡

64 密閉容器  
65 真空

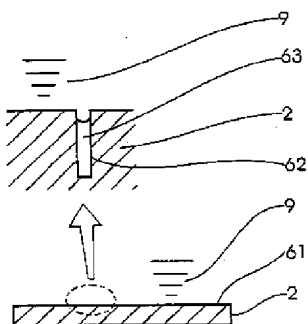
【図1】



【図3】

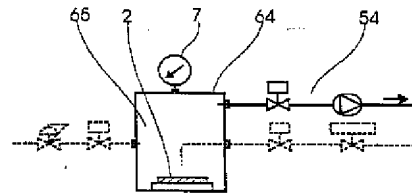


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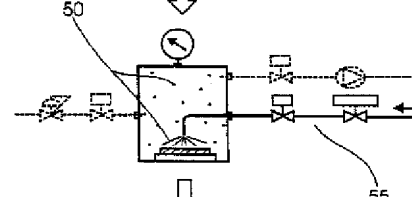


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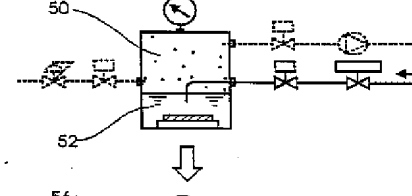
(a)



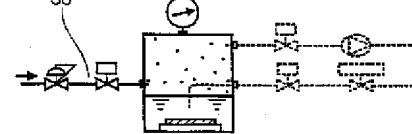
(b)



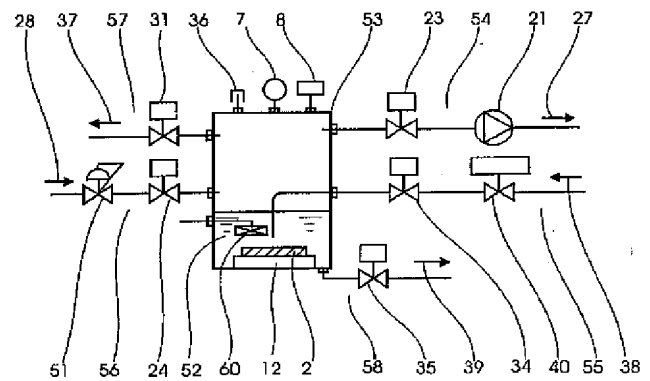
(c)



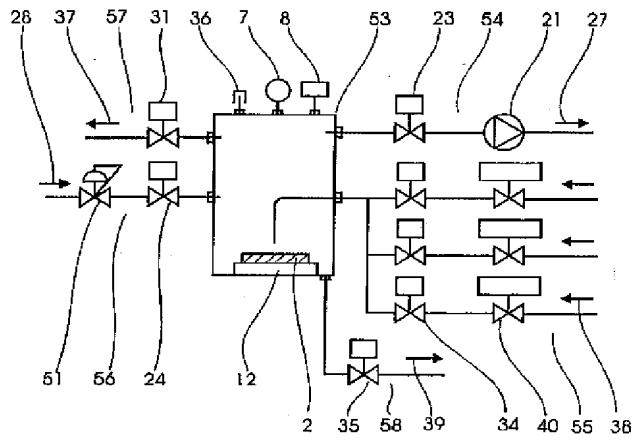
(d)



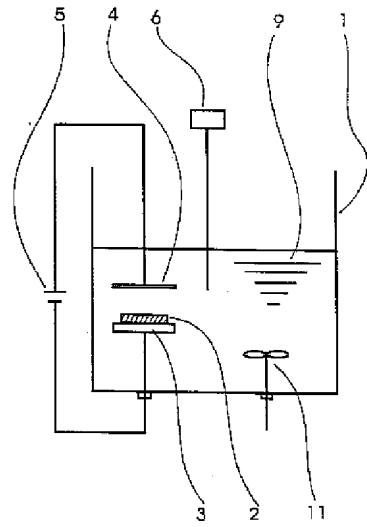
【図4】



【図5】



【図6】



**INFORMAL ENGLISH TRANSLATION OF**  
**JAPANESE REFERENCE NO. 11-80990**



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**TECHNICAL FIELD**

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[Field of the Invention] This invention relates to the pretreatment method of plating for plating to perform metal embedding to the minute groove formed especially on the substrate about the metallic wiring formation art which is the next-generation wiring technology of a semiconductor, and its device.

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[Translation done.]

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**PRIOR ART**

[Description of the Prior Art]Many aluminum has been used for circuit wiring material in the integrated circuit using a semiconductor. Aluminum wiring patterns by resist formation, after attaching an aluminum film to a substrate by sputtering process (Sputtering), and wiring formation is carried out by etching. Although it has come to be required with advanced integration of a circuit that wiring width should be formed more narrowly, many material property top problems of aluminum have come to arise. The conventional above-mentioned circuit formation may be difficult for the wiring formation by other metallic materials, Form the slot and hole for wiring beforehand and A chemical-vapor-deposition method (Chemical Vapor Deposition: following CVD method), Metal was embedded into the slot with techniques, such as sputtering process and the plating method, the surface polish of the surface was carried out by chemical machinery polish (Chemical Mechanical Polishing : following CMP) after that, and the method of forming circuit wiring has been taken.

[0003]The plating method is widely used as the metaled film attachment method.

It has many features.

Drawing 6 shows a fundamental plating device, and counters and arranges the anode electrode 4 and the cathode terminal 3 which attached the substrate 2 to be plated into the plating liquid 9 in the plating tub 1, and the stirrer 11 for plating liquid churning agitates the plating liquid 9 during plating operation. Washing of a substrate to be plated or etching is performed as pretreatment of plating, and pretreatment for making good plating liquid pouring to the minute groove on a substrate to be plated was not generally performed.

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[Translation done.]

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**EFFECT OF THE INVENTION**

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[Effect of the Invention]After exhausting noncondensing gas, such as air, from the surface of a substrate, the substance of a fluid is introduced into the container by ordinary temperature ordinary pressure, and a pressure is made to act further in this invention, as explained above. Therefore, a fluid can be introduced into a minute groove.

Therefore, plating liquid can be made to infiltrate into the minute groove by which pattern formation was carried out on the wafer substrate certainly, and plating can perform good metal embedding.

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**TECHNICAL PROBLEM**

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[Problem(s) to be Solved by the Invention]While there were the features, such as becoming possible [ the low temperature process with little thermal effect from which material with high purity with cheap process cost is obtained compared with other processes ] for the plating method, there was fault of plating liquid not permeating thoroughly the minute groove formed on the wafer substrate. The actual condition was that most metal embedding in particular by plating in a deep minute groove with a large aspect ratio is not performed.

[0005]When making plating liquid immerse the substrate with which the minute groove was formed to be plated, air remains in the minute groove and plating liquid does not usually permeate it thoroughly like drawing 7. The tendency becomes strong, so that it is thought that this is based on the influence of the wettability of a substrate to be plated, the surface tension of plating liquid, etc. and the width of a minute groove becomes narrow.

[0006]Then, an object of this invention is to provide the pretreatment method for plating which can make plating liquid infiltrate into the minute groove certainly as a plating process, and its device, in order to perform good metal embedding to the minute groove by which pattern formation was carried out on the wafer substrate by the plating method.

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[Translation done.]

continuation or introduction of a different fluid and a surface-active agent of a kind to coincidence may be enabled.

[0014]The invention according to claim 6 is the plating pretreatment system according to claim 5 having further a pressure fluctuation means which gives pressure fluctuation to a fluid in said processing chamber. The invention according to claim 7 is the plating pretreatment system according to claim 6, wherein said pressure fluctuation means is opening and closing or a selector-valve device formed in either [ at least ] said gas introductory route or a gas discharge path. The invention according to claim 8 is the plating pretreatment system according to claim 6, wherein said pressure fluctuation means is a supersonic vibration machine.

[0015]

[Embodiment of the Invention]Drawing 1 is a figure showing the outline of the plating pretreatment system of an embodiment of the invention. This pretreatment system makes the main components the processing chamber 53 of the vessel shape which can be sealed, and the evacuation piping 54, the liquid introduction pipe 55 and the gas introduction pipe 56 which were connected to this, and the gas discharge piping 57. The substrate base 12 which the pressure gauge 7, the pressure switch 8, and the safety valve 36 are attached to the processing chamber 53, and puts the substrate 2 on it is prepared for the processing chamber 53.

[0016]The evacuation piping 54 is provided with the opening and closing valve 23 and the vacuum pump 21, and can carry out evacuation of the processing chamber 53 even to required low pressure. It is connected to the nozzle in which the dietary source of liquid which is not illustrated carries out an opening on the substrate base of the processing unit 53 via the opening and closing valve 34 and the flow meter 40, and the liquid introduction pipe 55 can introduce into the processing chamber 53 the liquid of the specified quantity made into the purpose. The regulator 51 and the opening and closing valve 24 are formed in the gas introduction pipe 56, and the opening of the gas discharge piping 57 is carried out to the atmosphere via the opening and closing valve 31. The liquid exhaust 58 which formed the opening and closing valve 35 is connected to the bottom of the processing chamber 53. Discharge and a blow of liquid are possible by interlocking the gas introducing equipment 56 and the liquid exhaust 58.

[0017]The process of pretreating plating is explained using the device of such composition. It is the same as that of drawing 7 in a processed board, for example, the minute groove of as [ 0.2 micrometer in width and whose depth are 0.8 micrometer ] is formed in it. This substrate 2 is laid on the stand of a well-closed container, the exhaust valve 23 is opened, the exhaust air pump 21 performs vacuum suction, and as shown in drawing 2 (a), the noncondensing gas 27, such as air, is exhausted from the evacuation piping 54 to about 0.01 Torr.

[0018]Next, as shown in drawing 2 (b), proper fluids, such as plating liquid, water with high purity, and alcohol, are introduced into the well-closed container 64 via a nozzle from the liquid introduction pipe 55 by ordinary temperature ordinary pressure. A fluid evaporates within a container at first and exists in space as the gas 50. If it collects in a container as the fluid 52 and the substrate 2 immerses in the liquid as it is shown in the figure (c), when a fluid is furthermore supplied and the pressure in the well-closed container 64 reaches maximum vapor tension, the surface of the substrate 2 will touch the liquid.

[0019]In this state, in order that another power, such as surface tension, may act on the inner surface of the minute groove 62 on the substrate 2, steamy air bubbles remain. Then, the gas introduction valve 24 is opened, the gas 28 is introduced in the well-closed container 64 from the gas introduction pipe 56, and it pressurizes, or the air bubbles are crushed and liquid is made to infiltrate into detailed Mizouchi by making pressure vibration act, as shown in the figure (d). In the example of drawing 1, pressure vibration is given by opening and closing in a short cycle with the drive mechanism which does not illustrate the opening and closing valve 31 of the gas discharge piping 57, pressurizing by gas from the gas introduction pipe 56.

[0020]what a substance with small surface tension is chosen for to the construction material of

the substrate 2 as a fluid — or liquid can be made to infiltrate into a minute groove more certainly and efficiently by adding a surface active agent in liquid

[0021]After such pretreatment, take out the substrate 2 from the processing chamber 53, carry in to the plating tub 1 shown in drawing 6 as the surface does not dry, the plating liquid 9 is made to immerse, and electrolysis plating or nonelectrolytic plating is performed. Since the predetermined fluid is infiltrating into the minute groove 62 of the substrate 2 by pretreatment, the plating liquid 9 is supplied also to the inner surface of such a minute groove 62, and plating of this inner surface is promoted.

[0022]Although it is processing the one substrate 2 at a time, it may be made to process two or more sheets simultaneously in the device of drawing 1. In this case, when the cassette which accommodates two or more substrates 2 as exposes that surface is used, the substrate 2 pretreated before pretreatment can be taken out from the processing chamber 53 the whole cassette, and the efficiency of receipts and payments is good. If maintenance of a fluid is possible for a cassette, desiccation of the substrate 2 can be prevented also in the state where it took out. On the other hand, it is also possible to make the processing chamber 53 and a plating device serve a double purpose, and plating processing can be continuously performed following pretreatment in this case.

[0023]Drawing 3 is a figure showing the outline of the plating pretreatment system of another embodiment of this invention. Although this device is the same as that of the plating pretreatment system shown in drawing 1, and abbreviation, the methods which give pressure vibration differ. That is, the gas introduction pipe 56 and the flueing piping 57 have branched via the rotary valve 59. And by rotation of the rotary valve 59, the processing chamber 53 changes to the gas introduction pipe 56 and the flueing piping 57 by turns, and can give large pressure fluctuation.

[0024]Drawing 4 is a figure showing the outline of the plating pretreatment system of another embodiment of this invention. Although this device is the same as that of the plating pretreatment system shown in drawing 1, and abbreviation, the methods which give change to the pressure of the processing chamber 53 differ. That is, after the supersonic vibration machine 60 is arranged in the processing chamber 53 and the supersonic vibration machine 60 and the substrate 2 are immersed in the fluid 52, the supersonic vibration machine 60 can be operated and pressure vibration can be given to the substrate 2.

[0025]Drawing 5 is a figure showing the outline of the plating pretreatment system of another embodiment of this invention. Although this device is the same as that of the plating pretreatment system shown in drawing 1, and abbreviation, it differs in that the liquid introduction pipe 55 has two or more liquid introduction systems. Thereby, two or more sorts of liquid can be supplied to the processing chamber 53 at continuation or coincidence. Therefore, according to the kind and processing condition of a processed board, additives in which physical properties, such as the boiling point, differ, such as liquid and a surface active agent, can be supplied to the processing chamber 53 in the specified quantity and a predetermined procedure.

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[Translation done.]

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**DESCRIPTION OF DRAWINGS**

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**[Brief Description of the Drawings]**

**[Drawing 1]**It is a schematic diagram of the plating pretreatment system of the embodiment based on this invention.

**[Drawing 2]**It is a schematic diagram showing the liquid pouring process to the minute groove on a substrate.

**[Drawing 3]**It is a schematic diagram of the plating pretreatment system of the embodiment based on this invention.

**[Drawing 4]**It is a schematic diagram of the plating pretreatment system of the embodiment based on this invention.

**[Drawing 5]**It is a schematic diagram of the plating pretreatment system of the embodiment based on this invention.

**[Drawing 6]**It is a schematic diagram of a common plating device.

**[Drawing 7]**It is a schematic diagram showing the air bubbles which remain to the minute groove on the substrate in liquid.

**[Description of Notations]**

1 Plating tub

2 Substrate

3 Cathode terminal

4 Anode electrode

5 Power supply

6 Temperature detector

7 Pressure gauge

8 Pressure switch

9 Plating liquid

11 Stirrer

12 Substrate base

21 Vacuum pump

23 Opening and closing valve

24 Opening and closing valve

27 Exhaust gas flow direction

28 An introductory gas flow direction

31 Opening and closing valve

34 Opening and closing valve

35 Opening and closing valve

36 Safety valve

37 Exhaust gas flow direction

38 The direction of an introductory liquid flow

39 Effluent liquor flow direction  
40 Flow meter  
50 Steam  
51 Regulator  
52 Liquid  
53 Processing chamber  
54 Evacuation piping  
55 Liquid introduction pipe  
56 Gas introduction pipe  
57 Gas discharge piping  
58 Liquid discharge piping  
59 Rotary valve  
60 Supersonic vibration machine  
61 Plating side  
62 Minute groove  
63 Air bubbles  
64 Well-closed container  
65 Vacuum

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**DETAILED DESCRIPTION**

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**[Detailed Description of the Invention]****[0001]**

**[Field of the Invention]**This invention relates to the pretreatment method of plating for plating to perform metaled embedding to the minute groove formed especially on the substrate about the metallic wiring formation art which is the next-generation wiring technology of a semiconductor, and its device.

**[0002]**

**[Description of the Prior Art]**Many aluminum has been used for circuit wiring material in the integrated circuit using a semiconductor. Aluminum wiring patterns by resist formation, after attaching an aluminum film to a substrate by sputtering process (Sputtering), and wiring formation is carried out by etching. Although it has come to be required with advanced integration of a circuit that wiring width should be formed more narrowly, many material property top problems of aluminum have come to arise. The conventional above-mentioned circuit formation may be difficult for the wiring formation by other metallic materials, Form the slot and hole for wiring beforehand and A chemical-vapor-deposition method (Chemical Vapor Deposition: following CVD method), Metal was embedded into the slot with techniques, such as sputtering process and the plating method, the surface polish of the surface was carried out by chemical machinery polish (Chemical Mechanical Polishing : following CMP) after that, and the method of forming circuit wiring has been taken.

**[0003]**The plating method is widely used as the metaled film attachment method.

It has many features.

Drawing 6 shows a fundamental plating device, and counters and arranges the anode electrode 4 and the cathode terminal 3 which attached the substrate 2 to be plated into the plating liquid 9 in the plating tub 1, and the stirrer 11 for plating liquid churning agitates the plating liquid 9 during plating operation. Washing of a substrate to be plated or etching is performed as pretreatment of plating, and pretreatment for making good plating liquid pouring to the minute groove on a substrate to be plated was not generally performed.

**[0004]**

**[Problem(s) to be Solved by the Invention]**While there were the features, such as becoming possible [ the low temperature process with little thermal effect from which material with high purity with cheap process cost is obtained compared with other processes ] for the plating method, there was fault of plating liquid not permeating thoroughly the minute groove formed on the wafer substrate. The actual condition was that most metal embedding in particular by plating in a deep minute groove with a large aspect ratio is not performed.

**[0005]**When making plating liquid immerse the substrate with which the minute groove was formed to be plated, air remains in the minute groove and plating liquid does not usually permeate it thoroughly like drawing 7. The tendency becomes strong, so that it is thought that this is

based on the influence of the wettability of a substrate to be plated, the surface tension of plating liquid, etc. and the width of a minute groove becomes narrow.

[0006] Then, an object of this invention is to provide the pretreatment method for plating which can make plating liquid infiltrate into the minute groove certainly as a plating process, and its device, in order to perform good metal embedding to the minute groove by which pattern formation was carried out on the wafer substrate by the plating method.

[0007]

[Means for Solving the Problem] In a plating pretreatment method for plating so that the invention according to claim 1 may fill up with this detailed hollow a substrate which has a detailed hollow on the surface, it is a plating pretreatment method having a process of exhausting to a vacuum atmosphere containing said substrate, a process that said substrate is immersed in a fluid, and the process of pressurizing a fluid which surrounds said substrate.

[0008] If a substance of a fluid is introduced into the container by ordinary temperature ordinary pressure and a substrate to be plated immerses in the liquid by this after exhausting noncondensing gas, such as air, from the surface of a substrate, the surface of a substrate to be plated will touch the liquid. In order that another power, such as surface tension, may act on a minute groove on a substrate, air bubbles of hydraulic fluid vapor exist in detailed Mizouchi, but by making a pressure act, the air bubbles can be crushed and a fluid can be introduced into a minute groove.

[0009] The invention according to claim 2 is the plating pretreatment method according to claim 1 having the process of giving pressure fluctuation further to a fluid which surrounds said substrate. Thereby, air bubbles of hydraulic fluid vapor can be crushed and introduction of a fluid to a minute groove can be promoted further.

[0010] The invention according to claim 3 is the plating pretreatment method according to claim 1 characterized by using water, alcohol, plating liquid, or these mixed liquor as said fluid. These fluid kinds of selections are performed in consideration of wettability with a substrate, or relation with next plating processing.

[0011] The invention according to claim 4 is the plating pretreatment method according to claim 1 using a surface active agent which improves the wettability of a substrate in said immersion stage. Thereby, wettability with a substrate is reduced and introduction to a minute groove of a fluid is made easy. After these introduce a fluid surface active agent previously and make a wettability improvement of the detailed Mizouchi surface, it may be made to introduce a fluid, although it may add a priori into a fluid.

[0012] In a plating pretreatment system for plating so that the invention according to claim 5 may fill up with this detailed hollow a substrate which has a detailed hollow on the surface, it is a plating pretreatment system having a processing chamber which can seal, a vacuum exhaust path which performs exhaust air of this processing chamber, a liquid introductory route for supplying a fluid to said processing chamber, a gas introductory route for pressurizing a fluid in said processing chamber, and a gas discharge path for discharging gas from said processing chamber.

[0013] Two or more treating substrates may be processed simultaneously, and it may perform one sheet at a time to a batch type. In order to perform process processing, it is convenient to establish an effluent course which discharges a fluid. It may be made to use a pretreatment system also [ device / plating ]. Two or more liquid introductory routes may be established, and continuation or introduction of a different fluid and a surface-active agent of a kind to coincidence may be enabled.

[0014] The invention according to claim 6 is the plating pretreatment system according to claim 5 having further a pressure fluctuation means which gives pressure fluctuation to a fluid in said processing chamber. The invention according to claim 7 is the plating pretreatment system according to claim 6, wherein said pressure fluctuation means is opening and closing or a

selector-valve device formed in either [ at least ] said gas introductory route or a gas discharge path. The invention according to claim 8 is the plating pretreatment system according to claim 6, wherein said pressure fluctuation means is a supersonic vibration machine.

[0015]

[Embodiment of the Invention] Drawing 1 is a figure showing the outline of the plating pretreatment system of an embodiment of the invention. This pretreatment system makes the main components the processing chamber 53 of the vessel shape which can be sealed, and the evacuation piping 54, the liquid introduction pipe 55 and the gas introduction pipe 56 which were connected to this, and the gas discharge piping 57. The substrate base 12 which the pressure gauge 7, the pressure switch 8, and the safety valve 36 are attached to the processing chamber 53, and puts the substrate 2 on it is prepared for the processing chamber 53.

[0016] The evacuation piping 54 is provided with the opening and closing valve 23 and the vacuum pump 21, and can carry out evacuation of the processing chamber 53 even to required low pressure. It is connected to the nozzle in which the dietary source of liquid which is not illustrated carries out an opening on the substrate base of the processing unit 53 via the opening and closing valve 34 and the flow meter 40, and the liquid introduction pipe 55 can introduce into the processing chamber 53 the liquid of the specified quantity made into the purpose. The regulator 51 and the opening and closing valve 24 are formed in the gas introduction pipe 56, and the opening of the gas discharge piping 57 is carried out to the atmosphere via the opening and closing valve 31. The liquid exhaust 58 which formed the opening and closing valve 35 is connected to the bottom of the processing chamber 53. Discharge and a blow of liquid are possible by interlocking the gas introducing equipment 56 and the liquid exhaust 58.

[0017] The process of pretreating plating is explained using the device of such composition. It is the same as that of drawing 7 in a processed board, for example, the minute groove of as [ 0.2 micrometer in width and whose depth are 0.8 micrometer ] is formed in it. This substrate 2 is laid on the stand of a well-closed container, the exhaust valve 23 is opened, the exhaust air pump 21 performs vacuum suction, and as shown in drawing 2 (a), the noncondensing gas 27, such as air, is exhausted from the evacuation piping 54 to about 0.01 Torr.

[0018] Next, as shown in drawing 2 (b), proper fluids, such as plating liquid, water with high purity, and alcohol, are introduced into the well-closed container 64 via a nozzle from the liquid introduction pipe 55 by ordinary temperature ordinary pressure. A fluid evaporates within a container at first and exists in space as the gas 50. If it collects in a container as the fluid 52 and the substrate 2 immerses in the liquid as it is shown in the figure (c), when a fluid is furthermore supplied and the pressure in the well-closed container 64 reaches maximum vapor tension, the surface of the substrate 2 will touch the liquid.

[0019] In this state, in order that another power, such as surface tension, may act on the inner surface of the minute groove 62 on the substrate 2, steamy air bubbles remain. Then, the gas introduction valve 24 is opened, the gas 28 is introduced in the well-closed container 64 from the gas introduction pipe 56, and it pressurizes, or the air bubbles are crushed and liquid is made to infiltrate into detailed Mizouchi by making pressure vibration act, as shown in the figure (d). In the example of drawing 1, pressure vibration is given by opening and closing in a short cycle with the drive mechanism which does not illustrate the opening and closing valve 31 of the gas discharge piping 57, pressurizing by gas from the gas introduction pipe 56.

[0020] what a substance with small surface tension is chosen for to the construction material of the substrate 2 as a fluid — or liquid can be made to infiltrate into a minute groove more certainly and efficiently by adding a surface active agent in liquid

[0021] After such pretreatment, take out the substrate 2 from the processing chamber 53, carry in to the plating tub 1 shown in drawing 6 as the surface does not dry, the plating liquid 9 is made to immerse, and electrolysis plating or nonelectrolytic plating is performed. Since the predetermined fluid is infiltrating into the minute groove 62 of the substrate 2 by pretreatment,

the plating liquid 9 is supplied also to the inner surface of such a minute groove 62, and plating of this inner surface is promoted.

[0022] Although it is processing the one substrate 2 at a time, it may be made to process two or more sheets simultaneously in the device of drawing 1. In this case, when the cassette which accommodates two or more substrates 2 as exposes that surface is used, the substrate 2 pretreated before pretreatment can be taken out from the processing chamber 53 the whole cassette, and the efficiency of receipts and payments is good. If maintenance of a fluid is possible for a cassette, desiccation of the substrate 2 can be prevented also in the state where it took out. On the other hand, it is also possible to make the processing chamber 53 and a plating device serve a double purpose, and plating processing can be continuously performed following pretreatment in this case.

[0023] Drawing 3 is a figure showing the outline of the plating pretreatment system of another embodiment of this invention. Although this device is the same as that of the plating pretreatment system shown in drawing 1, and abbreviation, the methods which give pressure vibration differ. That is, the gas introduction pipe 56 and the flueing piping 57 have branched via the rotary valve 59. And by rotation of the rotary valve 59, the processing chamber 53 changes to the gas introduction pipe 56 and the flueing piping 57 by turns, and can give large pressure fluctuation.

[0024] Drawing 4 is a figure showing the outline of the plating pretreatment system of another embodiment of this invention. Although this device is the same as that of the plating pretreatment system shown in drawing 1, and abbreviation, the methods which give change to the pressure of the processing chamber 53 differ. That is, after the supersonic vibration machine 60 is arranged in the processing chamber 53 and the supersonic vibration machine 60 and the substrate 2 are immersed in the fluid 52, the supersonic vibration machine 60 can be operated and pressure vibration can be given to the substrate 2.

[0025] Drawing 5 is a figure showing the outline of the plating pretreatment system of another embodiment of this invention. Although this device is the same as that of the plating pretreatment system shown in drawing 1, and abbreviation, it differs in that the liquid introduction pipe 55 has two or more liquid introduction systems. Thereby, two or more sorts of liquid can be supplied to the processing chamber 53 at continuation or coincidence. Therefore, according to the kind and processing condition of a processed board, additives in which physical properties, such as the boiling point, differ, such as liquid and a surface active agent, can be supplied to the processing chamber 53 in the specified quantity and a predetermined procedure.

[0026]

[Effect of the Invention] According to this invention, as explained above, after exhausting noncondensing gas, such as air, from the surface of a substrate, the substance of a fluid can be introduced into that container by ordinary temperature ordinary pressure, and a fluid can be introduced into a minute groove by making a pressure act further. Therefore, plating liquid can be made to infiltrate into the minute groove by which pattern formation was carried out on the wafer substrate certainly, and plating can perform good metal embedding.

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[Translation done.]

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**CLAIMS**

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[Claim(s)]

[Claim 1] A plating pretreatment method characterized by comprising the following for plating so that a substrate which has a detailed hollow on the surface may be filled up with this detailed hollow.

A process of exhausting atmosphere containing said substrate.

A process in which a fluid is made to immerse said substrate.

A process of pressurizing a fluid which surrounds said substrate.

[Claim 2] The plating pretreatment method according to claim 1 having the process of giving pressure fluctuation to a fluid which surrounds said substrate.

[Claim 3] The plating pretreatment method according to claim 1 characterized by using water, alcohol, plating liquid, or these mixed liquor as said fluid.

[Claim 4] The plating pretreatment method according to claim 1 using a surface active agent which improves the wettability of a substrate in said immersion stage.

[Claim 5] A plating pretreatment system characterized by comprising the following for plating so that a substrate which has a detailed hollow on the surface may be filled up with this detailed hollow.

A processing chamber which can seal.

A vacuum exhaust path which exhausts this processing chamber.

A liquid introductory route for supplying a fluid to said processing chamber.

A gas introductory route for pressurizing a fluid in said processing chamber.

A gas discharge path for discharging gas from said processing chamber.

[Claim 6] The plating pretreatment system according to claim 5 having a pressure fluctuation means which gives pressure fluctuation to a fluid in said processing chamber.

[Claim 7] The plating pretreatment system according to claim 6, wherein said pressure fluctuation means is opening and closing or a selector-valve device formed in either [ at least ] said gas introductory route or a gas discharge path.

[Claim 8] The plating pretreatment system according to claim 6, wherein said pressure fluctuation means is a supersonic vibration machine.

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**CORRECTION OR AMENDMENT**


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[Kind of official gazette]Printing of amendment by the regulation of 2 of Article 17 of Patent Law

[Section classification] The 4th classification of the part III gate

[Publication date]April 7, Heisei 17 (2005.4.7)

[Publication No.]JP,11-80990,A

[Date of Publication]March 26 (1999.3.26), Heisei 11

[Application number]Japanese Patent Application No. 9-265027

[The 7th edition of International Patent Classification]

C25D 5/34

C25D 17/00

[FI]

C25D 5/34

C25D 17/00 L

[Written amendment]

[Filing date]May 11 (2004.5.11), Heisei 16

[Amendment 1]

[Document to be Amended]Specification

[Item(s) to be Amended]Claim

[Method of Amendment]Change

[The contents of amendment]

[Claim(s)]

[Claim 1]

In a plating pretreatment method for plating so that a substrate which has a detailed hollow on the surface may be filled up with this detailed hollow,

A process of exhausting atmosphere containing said substrate,

A process in which a fluid is made to immerse said substrate,

A plating pretreatment method having the process of pressurizing a fluid which surrounds said substrate.

[Claim 2]

The plating pretreatment method according to claim 1 having the process of giving pressure fluctuation to a fluid which surrounds said substrate.

[Claim 3]

The plating pretreatment method according to claim 1 characterized by using water, alcohol,

plating liquid, or these mixed liquor as said fluid.

[Claim 4]

The plating pretreatment method according to claim 1 using a surface active agent which improves the wettability of a substrate in said immersion stage.

[Claim 5]

In a plating pretreatment system for plating so that a substrate which has a detailed hollow on the surface may be filled up with this detailed hollow,

A processing chamber which can seal,

A vacuum exhaust path which exhausts this processing chamber,

A liquid introductory route for supplying a fluid to said processing chamber,

A gas introductory route for pressurizing a fluid in said processing chamber,

A plating pretreatment system having a gas discharge path for discharging gas from said processing chamber.

[Claim 6]

The plating pretreatment system according to claim 5 having a pressure fluctuation means which gives pressure fluctuation to a fluid in said processing chamber.

[Claim 7]

The plating pretreatment system according to claim 6, wherein said pressure fluctuation means is a supersonic vibration machine.

[The amendment 2]

[Document to be Amended] Specification

[Item(s) to be Amended] 0014

[Method of Amendment] Change

[The contents of amendment]

[0014]

The invention according to claim 6 is the plating pretreatment system according to claim 5 having further a pressure fluctuation means which gives pressure fluctuation to the fluid in said processing chamber.

It may be made for said pressure fluctuation means to be the opening and closing or the selector-valve device formed in either [ at least ] said gas introductory route or the gas discharge path.

The invention according to claim 7 is the plating pretreatment system according to claim 6, wherein said pressure fluctuation means is a supersonic vibration machine.

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[Translation done.]